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UNITED STATES DEPARTMENT OF AGRICULTURE
AND
STATE AGRICULTURAL EXPERIMENT STATIONS

METHODS OF COOKING AND TESTING MEAT
FOR PALATABILITY

Revised February, 1933

Supplement to National Project
Cooperative Meat Investigations

Issued for the Cooperators by the Bureau of Home Economics
and Bureau of Animal Industry, United States
Department of Agriculture

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1/ The Committee on Cooking and Palatability Methods for Meat is a standing committee reporting annually at the conference on Cooperative Meat Investigations. Officers of the organization during the development of these methods: Chairman, F.B. Mumford, Missouri Agricultural Experiment Station, 1924-1926; P.F. Trowbridge, North Dakota Agricultural Experiment Station, 1927-1930; W.C. Coffey, Minnesota Agricultural Experiment Station, 1931 to date. Secretary, E.W. Sheets, Bureau of Animal Industry, U.S. Department of Agriculture, 1924 to date.

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METHODS OF COOKING AND TESTING MEAT FOR PALATABILITY

(Revised, February, 1933)

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Importance of Standard Methods

Cooking occupies a position of great importance in cooperative meat investigations because it is the means of preparing meat for tests of palatability. According to the method of cooking employed, flavor, tenderness, and juiciness of meat are modified. Obviously, therefore, in studying the influence of production factors on the quality of cooked meat it is necessary to use the same method of cooking when testing any particular kind and cut. Similarly, characteristic differences in flavor, tenderness, and so forth, of various cuts of meat from the same animal can be determined only when the same method of cooking is used in their preparation. For the purpose of duplicating results, not only by the same workers but by different workers, standard methods were developed for use in cooking certain cuts of meat for palatability tests.

The standard methods issued in the cooperative project outline in 1927 and 1928, together with methods for bacon and fresh ham, have been revised, adopted as official by the committee, and are here presented. Tentative methods are presented for roasting beef chuck and broiling steaks. For guidance in experimental meat cookery, the committee offers suggestions on selection of samples, technique of cooking, and evaluation of results.

In the standard methods of cooking meat for palatability tests the committee has tried to present simple, explicit directions for cooking meat according to kind and cut under controlled conditions. Adequate laboratory equipment, careful handling and attention to detail are required for duplication of results. The standard methods are not necessarily adapted to the preparation of meat for the home or the institutional table. They bring out facts, however, that may be applied to cooking meats under all conditions.

The purpose of experimental cooking in relation to quality of meat is to preserve inherent characteristics as far as is consistent with good cooking and

maintenance of nutritive values. Probably the intensity of inherent flavor is least modified when meat is not cooked too much. The optimum degree of cooking varies in this respect for beef, lamb, pork, and veal. Seasoning is omitted because it may cover up flavor. Preservation of flavor, however, is but one of several points for consideration. In order that data may be translated into recommendations for the producer and the consumer, standard methods should be held as near as possible to satisfactory practical cooking methods. At the same time uniform cooking is essential when a cut of meat is to be judged and the only way to cook meat uniformly rare, medium, or well done, is to apply very moderate temperatures during most of the cooking period. This means long slow cooking, which is in some instances too slow to be practicable in the home or the institution.

The value of initial searing in the standard methods has been questioned. The committee is considering the simplification of the standard methods for roasting, by the omission of searing. However, while recognizing possible advantages in constant temperature roasting, the committee decided to experiment further before changing the present standard methods. To this end studies are proposed for determining a constant oven temperature that will cook meat as uniformly and with about the same amount of shrinkage as the present standard methods. The appearance of the meat when cooked, the length of time required, and the amount of fuel consumed will also be considered. Before modifying methods of cooking in these cooperative meat projects it is necessary to consider to what extent cooking losses and palatability factors may be affected because such data as may be obtained in the future with new standard methods may need to be interpreted in relation to data accumulated during the past seven years under present standard methods. Preliminary work indicates that a considerable number of comparative tests will be needed to obtain reliable conversion factors.

The development of methods for testing palatability of cooking meat offers wide opportunity for research. Experience has demonstrated the need for supplementing human judgment with objective tests. It is encouraging to report that rather close agreement has been found between estimates of the tenderness of cooked meat by judges' scores and by resistance to mechanical shearing. It is possible that significant quantitative determinations of juiciness may be made with a mechanical expresser. Tests recently developed for determining reactions to taste stimuli offer a promising field for studies on meat flavor as well as for determination of the qualifications of judges.

Before collaborators undertake to cook and test meat from experimental animals it is necessary that they become thoroughly familiar with all the details of procedure. To this end, right and left cuts from the same animal should be tested in the same way to check methods. This preliminary work should be planned to furnish judges opportunities to test meat representing extreme and intermediate grades of quality.

Equipment for Cooking and Testing Meat for Palatability

Ovens.- Gas or electric ovens with temperature control and preferably with glass doors or windows. Thermometers or thermocouples are placed in the ovens at specified locations to indicate the temperatures.

Refrigerator.- Either a mechanical or an ice refrigerator, large enough to hold conveniently a day's cooking schedule of samples when set up in pans. If uncooked meat is stored overnight or longer the temperature should be from 7° to 8°C. (45° F.) or lower.

Pans.- Open pans of ordinary sheet iron, about 2-1/2 inches deep. For pork loin, leg of lamb, and for average-sized beef ribs, pans about 10 by 14 inches, top measure. For large beef roasts and for hams, pans 12 by 17 inches top measure. Covered roasters for veal (see special directions for roasting veal). For ham boilers, see special directions for hams cooked in water. Numbered nonrusting metal tags attached to pans for identification.

Racks.- Wire racks to hold roasts out of drippings.

Trays.- Shallow white enamel trays 14 by 17 inches identified by means of Roman numerals scratched on one corner of each.

Balance.- A 20-kilogram solution balance is recommended.

Rulers.- One 50-centimeter ruler and two 12-inch rulers.

Thermometers.- The following specifications are based on information from the United States Bureau of Standards. For use in both ovens and meat, thermometers should be the nitrogen-filled, mercury-in-glass type, calibrated on the basis of total immersion.

Oven thermometers must have scale divisions engraved on the stem, and the temperature range should be 100° to 300°C. A convenient over-all length for an oven thermometer mounted in a metal support is 8 inches.

The temperature range of the meat thermometer should be from 0° to 100°C., and the scale divisions may be 1° or 2°C. Two types of meat thermometers have been found satisfactory: the straight tube and the right angle. Either of these types may be constructed as a maximum thermometer if desired. The straight-tube thermometer should be 6 to 7 inches long, with graduations beginning at least 3 inches above the bulb. The right-angle thermometer is particularly convenient to use in standing rib roasts of beef, because it has an ungraduated horizontal arm about 3-1/2 inches long and a vertical arm from 4 to 5 inches long which contains all the graduations. For special thermometers needed for veal cooking, see directions for veal. Special orders for all meat thermometers will probably have to be placed with instrument companies.

Thermocouples.- Changes in the temperature of the meat in the oven can not always be observed with a thermometer. Thermocouples may be necessary, but they are difficult to use in cooking because the wires leading from the couples pass through air at a temperature much higher than that which is being measured. Conduction of heat along the wire may possibly give false results.

Various types of thermocouples were constructed in an effort to find those most suitable for use in cooking meat. Some thermocouples were made with both wires encased in a metal sheath, some with a single wire inclosed in a metal sheath and insulated from it by a glass covering, and some with bare wires insulated from each other by a thin strip of paper or fiber packing. Chromel-alumel and copper-constantan couples were made of several sizes of wire to determine the largest size that could be used without appreciable error due to heat conduction. Practically all the tests were made on beef roasted to the rare stage. As a result of these experiments all types of couples were eliminated as unsatisfactory except those in which bare wires were put directly into the meat. Tests on chromel-alumel couples showed that wires as large as No. 20 might be used, whereas No. 20 copper-constantan wire is too large. Studies are not complete for copper-constantan couples, but it was found that in all cases the temperature measurements were affected by heat conduction along copper-constantan wires unless they were of such fineness as to be too fragile for everyday use. Our recommendation is that thermocouples be made of chromel-alumel wire not larger than No. 22, and that the wire in contact with meat be bare. For other meat than beef it is possible that another size of wire may be advisable.

Caliper and planimeter for measuring bacon.

Skewers. - Several skewers, steel and wooden.

Flashlight.- Flashlight of the focusing type for reading thermometers in the ovens without opening the glass doors. A shaded electric light bulb on a long cord may be substituted for a flashlight.

Timepieces.- A reliable stop watch to determine time intervals in recording temperatures. In addition an ordinary clock or watch.

Drawing table.- For mounting cooking sheet 5.

Carving equipment.- A carving knife and fork, also a boning knife. A thin, fairly stiff, scimitar-shaped knife, 12 inches or more in length and at least an inch wide, is satisfactory. It should always be well sharpened and while being used should be whetted occasionally, with a steel and carborundum stone. A carving board of good size and a shallow tray to hold the carving board.

Serving equipment.- Four dozen china plates, 6 or 7 inches in diameter. About six table knives and forks. One light aluminum tray for serving.

Tenderness-testing machine.- See General Directions.

Plugging cylinder. See General Directions.

Forms for recording data. The forms given in the following pages have been developed in the course of the project for recording cooking and palatability data.

Sheet 1

MEAT COOKING RECORDS Date

History of Sample

Kind of meat Source

Cut of meat Place where cooked

Animal number Cooking laboratory serial number

1. Object of meat investigation

2. Animal

Breed Date of slaughter

Sex Feeder grade

Ration Slaughter grade

Age at time of slaughter Carcass grade

3. Handling meat

Storage Cure

Temperature Method

Humidity Temperature

Time or length of ripening period Time

Other treatment Smoke

Method

Temperature

Time

Sheet 2

MEAT COOKING RECORDS

Date _____

Description of Beef Ribs before Cooking

Cooking laboratory serial number				
Animal number				
Weight of cut, grams				
Width of cut over center of eye, mm.				
Straightline length from chine bone to cut end 11th rib, mm.				
Texture				
Very fine				
Fine				
Slightly coarse				
Coarse				
Very coarse				
Marbling of lean eye				
Very abundant and extensive				
Abundant and extensive				
Moderate, limited distribution				
Traces				
None visible				
Character of fat, external and internal				
Very firm and very brittle				
Firm and brittle				
Moderately firm				
Soft				
Very soft				
Firmness of lean				
Very firm				
Firm				
Moderately firm				
Soft				
Very soft				

Sheet 2a

MEAT COOKING RECORDS

Date - _____

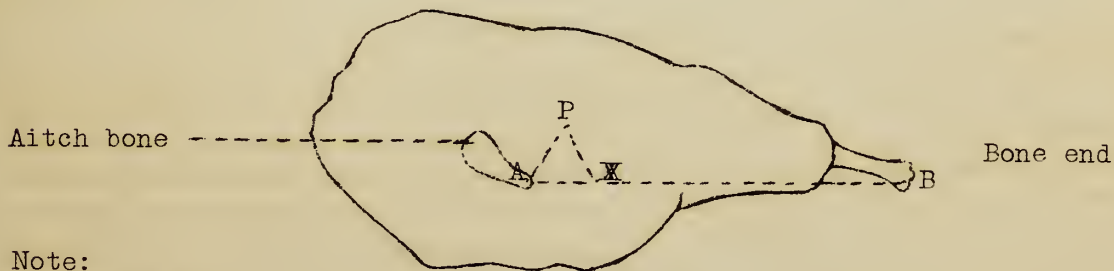
Description of Leg of Lamb before Cooking

Cooking laboratory number				
Animal number				
Finish (degree) <u>1/</u>				
Trim (extent) <u>2/</u>				
Mutilations <u>3/</u>				
Length AB (below), mm.				
Length AX (below), mm. (AB ÷ 6)				
Weight of bone end, grams				
Depth of round at point P, inches				

1/ Finish is described by thirds of grades, ranging from 1-(0.67) for the heaviest fat covering to 5+(5.33) for complete absence of fat. Average degree of finish is described as 3.

2/ Trimming of the fat covering of the inside round of the leg is also described by thirds of grades. The least possible stripping or cutting of the natural fat covering over the round is described as 1-(0.67), and the stripping of all fat covering from the inside round by 5+(5.33).

3/ Mutilations include gashes, tears, and other cuts in the outer cover and the muscles of the inside round, due to careless handling. Describe the kind of mutilation, if any. If there are no mutilations write the symbol 0 in the space provided.



Note:

AP = PX = AX

Left leg

Sheet 2b

MEAT COOKING RECORDS

Date _____

Grading Chart for Appearance of Fresh Pork before Cooking

Cooking laboratory serial number _____

Cut _____

Animal number _____

	5	4	3	2	1
Shape	Well rounded	Moderately rounded	Slightly rounded	Tends to be flat or angular	Flat or angular
Trim	Smooth and even	Moderately smooth and even	Lean unevenly covered	Patchy with bare places	50% or more lean exposed
Proportion* fat to lean	Good	Moderately good	Fair	Poor	Very poor
Marbling	Abundant and extensive	Moderate and extensive	Poor	Traces	None visible

*For the grades designated as 4, 3, 2, and 1 check one of the following:

Excess of fat
Deficiency of fat

Sheet 2c

MEAT COOKING RECORDS

Date _____

Grading Chart for External Appearance of Fresh Pork after Cooking

Cooking laboratory serial number _____ Cut _____

Animal number _____

	5	4	3	2	1
Shape	Very plump	Plump	Slightly shrunk	Shrunk	Greatly shrunk
Proportion* fat to lean	Good	Moderately good	Fair	Poor	Very poor
Color of fat	Rich brown	Light brown	Dull brown	Slightly pale	Very pale

*For grades designated as 4, 3, 2, and 1 check one of the following:

Excess of fat

Deficiency of fat

Description of Bacon before Cooking

Cooking laboratory serial number _____

Animal number _____

Bacon Side

Weight, grams _____

Length, mm. _____

Width center, mm. _____

Width flank end, mm. _____

Width brisket end, mm. _____

Average width, mm. _____

Ratio length to width _____

Thickness of skin, mm. (caliper) _____

Skinned Slices

Color of lean* _____

Color of fat* _____

Color of skin* _____

Firmness of fat

a. Refractive index
or iodine number _____b. By thumb pressure after
24 hours storage at 4°C. _____

Width (center)**mm. _____

Length (center)**mm. _____

Proportion of fat to lean
from planimeter readings** _____

Distribution of fat and lean _____

* Preferably by an objective method such as Munsell.

** Taken from parchment paper tracing.

Data for Determining Cooking Losses

Cooking laboratory serial number				
Kind and number of animal				
Weights to be determined	<u>Grams</u>	<u>Grams</u>	<u>Grams</u>	<u>Grams</u>
A. Before cooking:	1*	2*	3*	4*
1. Weight of pan				
2. Weight of thermometer				
3. Weight of roast				
4. Weight of pan, roast, and thermometer				
B. On removal from oven:				
1. Weight of pan, roast, thermometer, and drippings	I**	II**	III**	IV**
2. Weight of platter for roast				
3. Weight of platter, roast, and thermometer				
4. Weight of pan and drippings				
C. When roast reaches its maximum temperature:				
1. Weight of platter, roast, thermometer, and drippings collected while standing				
2. Weight of platter and drippings collected while standing				

* Pan numbers

** Tray numbers

Sheet 4

MEAT COOKING RECORDS

Date _____

Calculations of Cooking Losses from Data on Sheet 3

Cooking laboratory serial number				
Kind and number of animal				
I. Losses by weight	<u>Grams</u>	<u>Grams</u>	<u>Grams</u>	<u>Grams</u>
D. Loss due to evaporation				
1. In the oven, A4-B1				
2. Outside the oven, *B3-C1				
3. Total, D1 + D2				
E. Loss as drippings				
1. In the oven, B4-A1				
2. Outside the oven, *C2-B2				
3. Total, E1 + E2				
F. Total loss during cooking				
D3 E3				
G. Check, A3- (C1-C2-A2)				
Weight of uncooked roast (A3)				
Weight of cooked roast (C1-C2-A2)				
II. Losses as per cent of weight	<u>Per cent</u>	<u>Per cent</u>	<u>Per cent</u>	<u>Per cent</u>
of uncooked roast				
H. Loss due to evaporation				
1. In the oven, D1 ÷ A3				
2. Outside the oven, *D2 ÷ A3				
3. Total, D3 ÷ A3				
I. Loss as drippings				
1. In the oven, E1 ÷ A3				
2. Outside the oven, *E2 ÷ A3				
3. Total, E3 ÷ A3				
J. Total loss during cooking				
F ÷ A3				
K. Check, G ÷ A3				

* From the time when the roast is removed from the oven until it reaches its maximum temperature reading.

Sheet 5

MEAT COOKING RECORDS

Date _____

Oven Chart

Cooking laboratory serial number

Pan number

Kind and number of animal

Oven number

[illegible]

Sheet 6

MEAT COOKING RECORDS

Date _____

Summary of Miscellaneous Data

Kind of oven _____

Cut of meat _____

Cooking laboratory serial number _____

Kind and number of animal _____

Oven temperature _____

Average oven temperature for
searing, °C. _____Average oven temperature,
slow cooking, °C. _____

Meat temperature, at center of cut:

Initial, °C. _____

On removal from searing oven, °C. _____

Rise, in searing oven, °C. _____

On removal from slow oven, °C. _____

After removal from oven,
Maximum reached °C. _____

Rise, after removal from oven, °C. _____

Time in rising, min. _____

Time-weight relations:

Searing time, min. _____

Slow cooking time, min. _____

Total time in oven, min. _____

Weight of uncooked roast {
(grams _____
(lbs. _____

Minutes per pound _____

MEAT COOKING RECORD
GRADING CHART FOR COOKED MEAT

SHEET No. 7 Cooking Laboratory No. Sample No. Kind Date

Factor	Phase	7	6	5	4	3	2	1	Remarks
Aroma	Intensity	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Perceptible	Slightly perceptible	Imperceptible	What aroma?
	Desirability	Very desirable	Desirable	Moderately desirable	Slightly desirable	Neutral	Slightly undesirable	Undesirable	Normal or abnormal?
Texture (Grain)	Intensity	Very fine	Fine	Moderately fine	Slightly coarse	Coarse	Very coarse	Extremely coarse	
	Desirability	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Perceptible	Slightly perceptible	Imperceptible	What flavor?
Flavor of fat	Intensity	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Neutral	Slightly undesirable	Undesirable	Normal or abnormal?
	Desirability	Very desirable	Desirable	Moderately desirable	Slightly desirable	Perceptible	Slightly perceptible	Imperceptible	What flavor?
Flavor of lean	Intensity	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Neutral	Slightly undesirable	Undesirable	Normal or abnormal?
	Desirability	Very desirable	Desirable	Moderately desirable	Slightly desirable	Perceptible	Slightly perceptible	Imperceptible	What flavor?
Tenderness	Intensity	Very tender	Tender	Moderately tender	Slightly tough	Tough	Very tough	Extremely tough	
	Desirability	Very rich	Rich	Moderately rich	Slightly rich	Perceptible	Slightly perceptible	Imperceptible	
Quality of juice	Intensity	Very juicy	Juicy	Moderately juicy	Slightly dry	Dry	Very dry	Extremely dry	
	Desirability								

COLOR OF LEAN COLOR OF FAT NOTE.—Encircle the words which describe intensity; mark desirability and color with a check.

1. Light red.
2. Dark pink.
3. Light pink.

4. Pinkish brown.
5. Light brown.
6. Dark brown.
1. White.
2. Creamy white.
3. Grayish cream.

4. Yellowish brown.
5. Yellow.
6. Amber.
- (Signature of judge)

MEAT COOKING RECORD

GRADING CHART FOR COOKED CURED MEATS *

SHEET No. 7a

Date

Cooking Laboratory No. Animal No. Kind of meat Judged hot or cold ?

Portion	Factor	7	6	5	4	3	2	1	Remarks
Entire sample	Aroma	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Perceptible	Slightly perceptible	Imperceptible	
	Aroma smokiness	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Perceptible	Slightly perceptible	Imperceptible	
	Translucence	Very translucent	Translucent	Moderately translucent	Slightly translucent	Cloudy	Very cloudy	Opaque	Granular; Yes..... No.....
	Firmness	Very hard	Hard	Medium hard	Medium soft	Soft	Oily	Very oily	
Fat	Waxiness	Very waxy	Waxy	Moderately waxy	Slightly waxy	Slightly pasty	Pasty	Very pasty	
	Flavor	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Perceptible	Slightly perceptible	Imperceptible	
	Texture	Very fine	Fine	Moderately fine	Slightly coarse	Coarse	Very coarse	Extremely coarse	
	Cohesion	Very flaky or crumbly	Flaky or crumbly	Slightly crumbly	Slightly cohesive, crumbly	Moderately cohesive	Cohesive	Very cohesive	
Lean	Firmness	Very firm	Firm	Moderately firm	Slightly firm	Moderately soft	Soft	Mushy or pasty	
	Flavor	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Perceptible	Slightly perceptible	Imperceptible	
	Saltiness	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Perceptible	Slightly perceptible	Imperceptible	
	Tenderness	Very tender	Tender	Moderately tender	Slightly tough	Tough	Very tough	Extremely tough	Stringy residue; Yes..... No.....
	Quantity of juice	Very juicy	Juicy	Moderately juicy	Slightly dry	Dry	Very dry	Extremely dry	

KIND OF AROMA—ENTIRE SAMPLE					KIND OF FLAVOR—FAT			KIND OF FLAVOR—LEAN		
a. Pungent.	f. Sour.	k. Musty.	a. Pungent.	f. Sour.	f. Sour.	k. Musty.	a. Pungent.	f. Sour.	k. Musty.	
b. Flat.	g. Sweet.	l. Other aroma.	b. Flat.	g. Sweet.	g. Sweet.	l. Rancid.	b. Flat.	g. Sweet.	l. Other flavor.	
c. Cheesy.	h. Spoiled.	m. Rancid.	c. Cheesy.	h. Spoiled.	h. Spoiled.		c. Cheesy.	h. Spoiled.	m. Rancid.	
d. Stale.	i. Fresh meat.		d. Stale.	i. Fresh meat.	i. Fresh meat.		d. Stale.	i. Fresh meat.		
e. Spicy.	j. Briny.		e. Spicy.	j. Other flavor.	j. Other flavor.		e. Spicy.	j. Briny.		

NOTE 1. Encircle words in ruled portion of chart; mark kind of aroma and flavor with check.

NOTE 2. After grading, rank the samples in order of preference, stating reasons.

Rank of this sample

Reason

* Adapted from chart developed at Maryland Agricultural Experiment Station.

MEAT COOKING RECORDS

Date

Summary of Scores from Grading Charts for Cooked Meat

Cooking laboratory serial number

Kind of meat

Animal number

Cut of meat

[illegible]

Sheet 9

MEAT COOKING RECORDS

Date _____

Mechanical Shearing Test for Tenderness

Kind of meat _____

Raw or cooked?

[illegible]

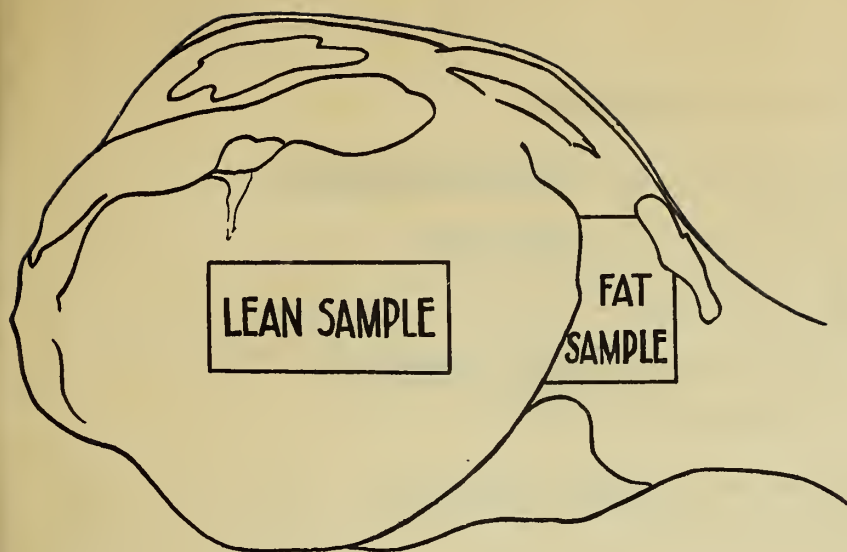


Fig. 1. Slice from center of rib roast of beef showing location of lean and fat samples for judges.

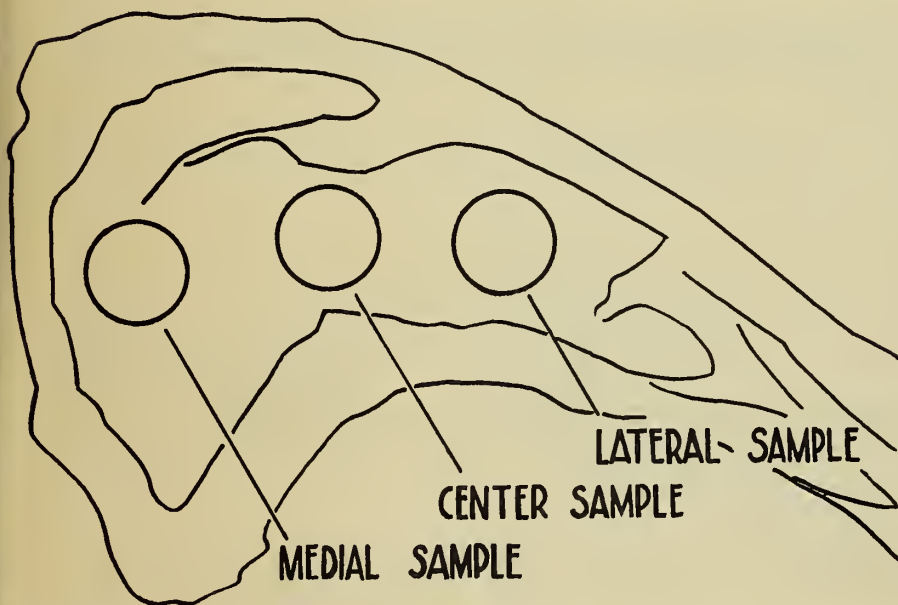
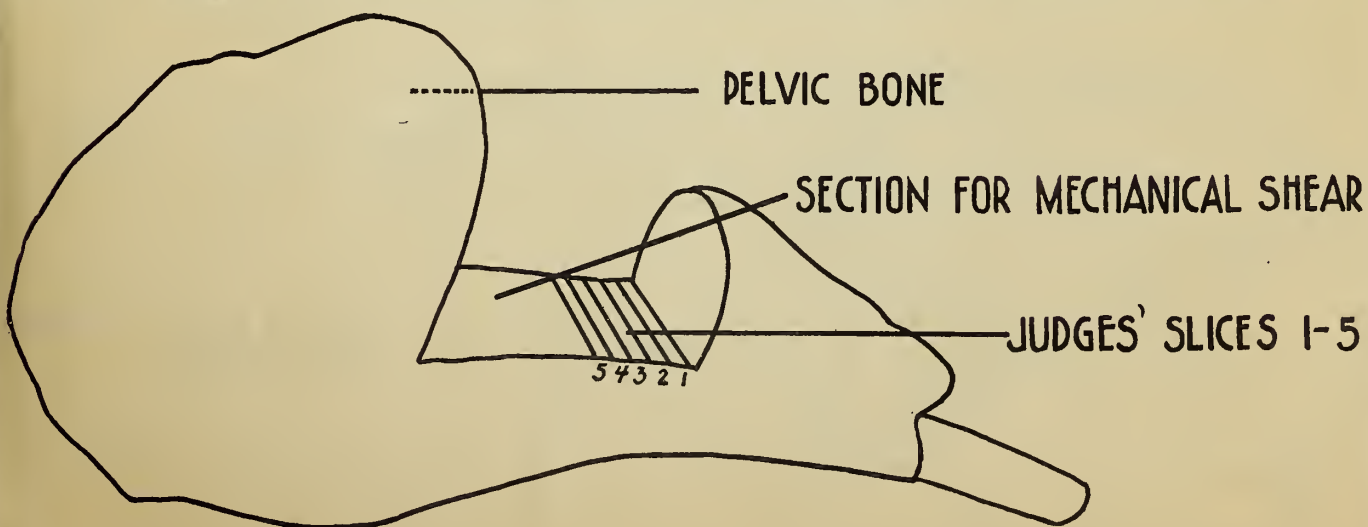


Fig. 2. Cross section of rib roast of beef showing location of samples for mechanical shear.

Fig. 3. Left leg of lamb after removal of judges' slices and section for mechanical shear.



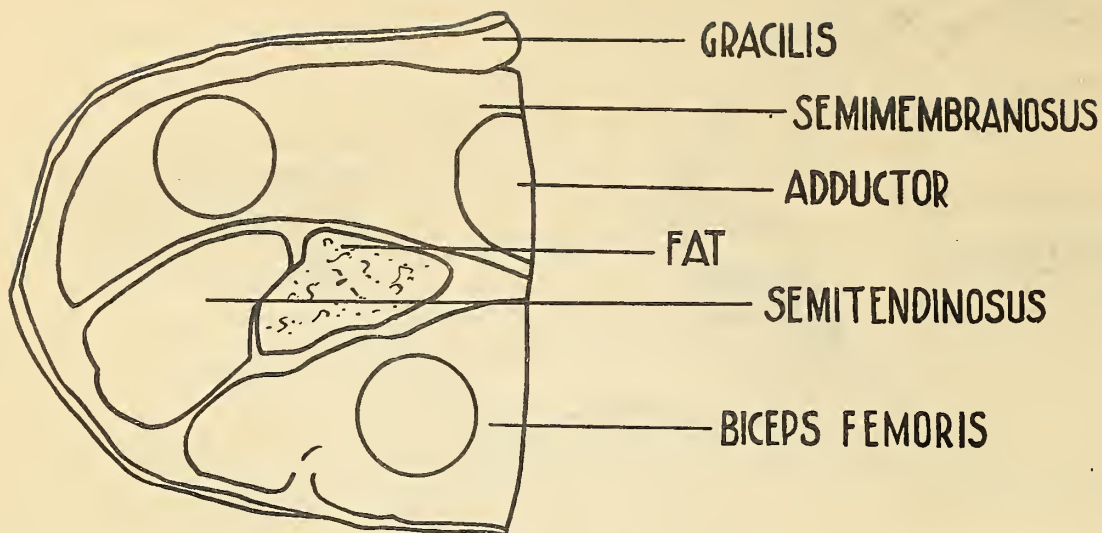


Fig. 4. Slice from leg of lamb showing location of muscles and fat around the popliteal gland for judges' samples. Circles show location of samples for mechanical shear.

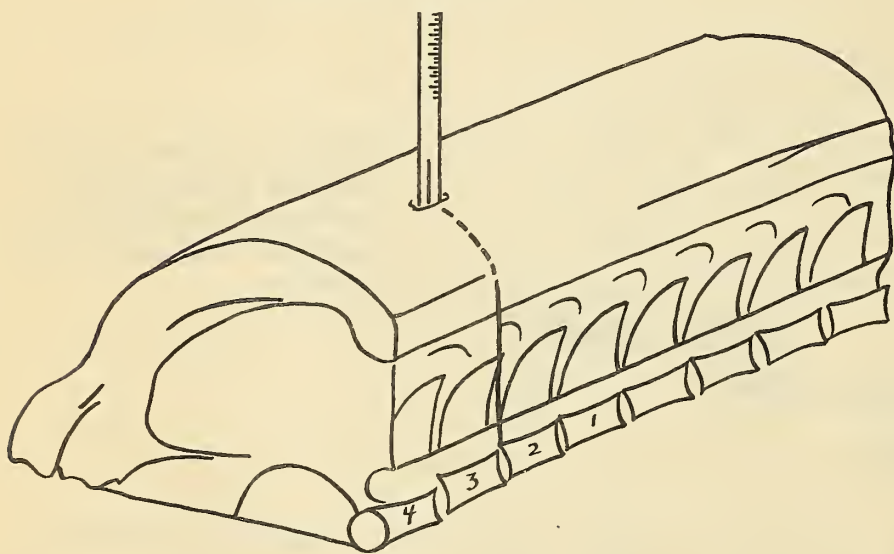


Fig. 5. Pork loin with meat thermometer in place.

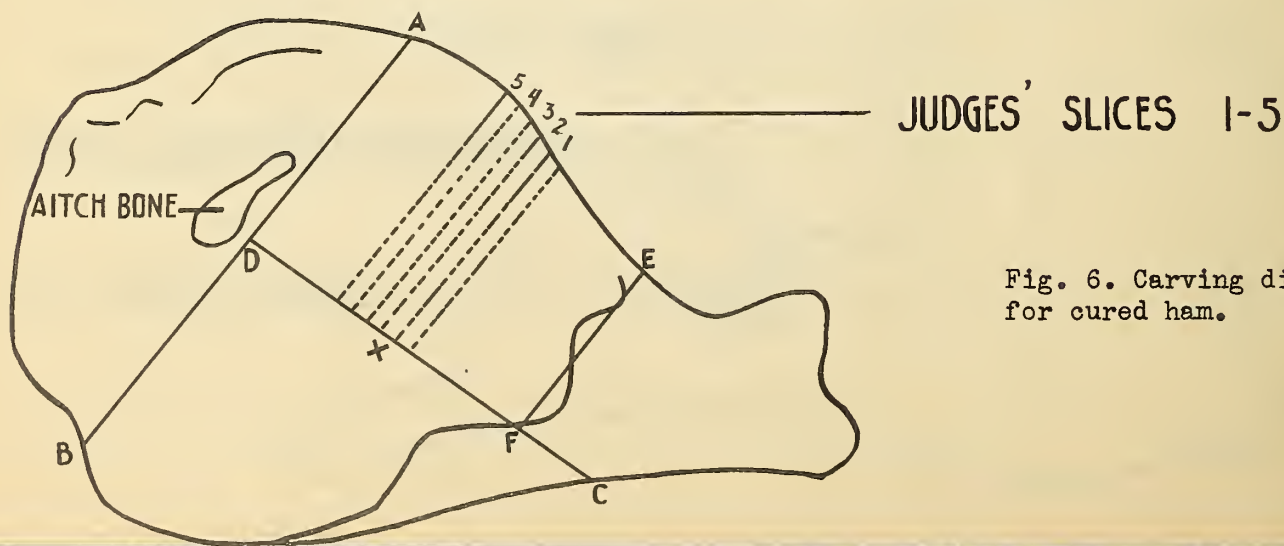


Fig. 6. Carving diagram for cured ham.

General Directions for Cooking and Testing Meat for Palatability

The following general directions apply to the cooking and judging of all meat samples, and should be followed together with the specific directions for beef ribs, leg of lamb, and other kinds and cuts. Details of manipulation are included at the request of members of the committee.

I. Preparation of meat samples for cooking

When samples from experimental animals are to be cooked and tested, the animal husbandmen should notify the cooking laboratory and provide daily delivery and cooking schedules that show source of samples, lot numbers, individual numbers, and slaughter dates. If possible, have samples delivered the day before they are to be cooked.

Beef ribs should be cooked 10 days after slaughter, fresh pork 7 days, and veal 7 days. No definite time has been set for ripening lamb, but tests show on the average increased tendering of the meat during the first 10 days in storage at 4° to 6°C. Keep the ripening period the same when testing the palatability of meat from different lots in a series of experiments.

As soon as the meat reaches the cooking laboratory, record the sample numbers and the cut, and the side from which the cut was taken. If this information does not check with the schedule received from the animal husbandmen, report discrepancies and have mistakes corrected at once.

Weigh the pieces of meat and record measurements and descriptive data on the special sheets provided. Store the meat overnight in a refrigerator, at 7° to 8°C, or lower.

Wipe the fresh meat samples with a damp cloth. If "strong" or sticky due to ripening, sponge with a dilute solution of baking soda, and then with clear water. Scrub cured meat, scrape off mold, and sponge with dilute vinegar.

Remove such undesirable portions as the spinal cord. Do not trim the sample further unless necessary to make it fit the pan.

Line up the samples according to lots. When there are several lots of animals represented and the cooking period extends over a period of days, rotate the order of the lots, so that no one lot is cooked throughout in the same oven. For each sample, record on the identification tag the cooking laboratory serial number, and the pan number. Enter these numbers on Sheet 7 at this time. Leave tags on samples until it is time to weigh. Then detach the tag from one sample, and place it in front of the balance while weighing that sample. After weighing return the tag to the pan until all numbers are checked. Weigh as indicated on Sheet 3, section A. Record the number of the meat thermometer used in each sample. The sum of the separate weights of the pan, thermometer, and meat should equal the weight of the combination of pan, thermometer, and meat ($A_1 + A_2 + A_3 = A_4$). A tolerance of 0.5 per cent (one half of 1 per cent) is permitted in the check sum.

The roasts are cooked without water and without seasoning. Replace the samples in their pans in the refrigerator in regular order until time to sear them. Two or three hours' storage seldom changes the weight of the meat appreciably. At the beginning of the searing period all roasts should have about the same initial temperature, preferably about 8°C.

II: Cooking meat samples

Schedule planning

In planning the schedule consider weight, finish, trim, etc. For approximate number of minutes per pound, see specific directions for different cuts and kinds of meat. The figures given are averages, and individual cases will vary. The samples are to be served one at a time to the judges at intervals of about 10 minutes. Allow for this in planning the schedule.

Preparation of gas ovens for roasting

To cook eight roasts a day two or three ovens are needed for searing, and a sufficient number of other ovens to provide space for the roasts during the slow cooking period. Place the roasting shelf in the lowest ledges of gas ovens. Light the ovens 30 minutes beforehand.

Regulate searing ovens so as to give a temperature of approximately 270°C. as registered by the oven thermometer located in the right-hand corner of the roasting shelf 2 or 3 inches back from the door, or by thermocouples if used. The average of the temperatures read at intervals during the searing period should be between 260° and 265°C. (See specific directions for exceptions.) Since no two ovens respond to heat regulators in exactly the same way, experiment with each oven to find out what the initial temperature should be in order to give the desired average temperature. Heat the slow ovens to the temperature indicated in the specific directions. Change the oven regulator only when necessary to give the desired oven temperatures as shown by the thermometer.

Be very cautious about changing the regulator during the searing period. A slight resetting upwards may raise the temperature much higher than expected. Some ovens require that regulators be reset downwards for several divisions to reduce the searing temperature materially. The temperature change resulting from resetting of the regulator can be determined only by experience with the ovens. Note it carefully for future reference.

Slow oven temperatures usually are fairly constant, but must be observed frequently. When the temperature falls 2° to 3° below that desired, turn the regulator slowly until a slight increase in the gas flow is heard. Then slow oven temperatures are too high by several degrees, reduce them by turning the regulator down slightly and guardedly opening the oven door for a few seconds. Close the door slowly and evenly for uniform circulation of air, also to prevent back-firing of burners.

Procedure for roasting meat samples

Record on Sheet 5 the searing oven number and temperature, and the tem-

perature of the meat. Place the meat in the oven lengthwise, heavy end to the front. Record on Sheet 5 the stop-watch reading, the reading by a regular watch, and the reading on the oven regulator. During the 20-minute searing period, take readings of the oven temperature through the glass door at 0, 2, 6, 10, 14, 18, and 20 minutes. Just before the end of the searing period, record the oven number and the temperature of the slow oven into which the sample is to go, the searing-oven temperature, and the meat temperature. Then transfer the meat. For each sample enter on Sheet 5 in the upper-right-hand corner and also in the left margin the numbers of the ovens used. Take slow-oven readings at intervals of about 10 to 15 minutes. Read the meat thermometers and record temperatures occasionally until the meat temperature is approximately 5° below the end point. Thereafter take readings more often. When the meat has reached the required temperature record it and also the oven temperature, stop-watch time and time on a regular watch. Remove the meat from the oven and weigh at once as directed on Sheet 3, section B.

With a colored pencil, mark the trays so that the cooking laboratory serial numbers, Roman numerals, and pan numbers, as shown on Sheet 3 correspond. (See section on Equipment.) For example, tray ^{no.} I should then have sample number 552B marked on it and receive the sample from pan No. 1. Tray No. II marked 553B receives the sample from pan No. 2, etc. Check the identity of the samples on the white-enamel trays by means of the numbers of the meat thermometers.

Check weights immediately as follows:

1. Weight of pan, thermometer, ^{and} meat before cooking minus weight of pan, thermometer, and meat and drippings on removal from oven gives loss due to evaporation in the oven, or Sheet 3, A4 - B1.
2. Weight of pan and drippings minus weight of pan gives weight of drippings loss in the oven, or Sheet 3, B4 - A1.
3. Add losses due to evaporation and drippings in the oven. This sum is total loss in cooking.
4. Weight of platter, thermometer, and meat on removal from oven minus weight of platter and thermometer gives weight of cooked meat, or Sheet 3, B3 - (B2 + A2).
5. Weight of raw meat minus weight of cooked meat equals total loss in cooking.
6. Items 3 and 5 should check within 0.5 per cent (one-half of 1 per cent).

For rare beef roasts, cured hams, or for any other cut that is to be weighed again when it reaches final maximum temperature outside the oven, check immediately as described above, and check again after final weighing, following the system on Sheet 4. As soon as the weights of the sample are checked and the description if any taken, the meat is ready to be carved.

III. Palatability tests and mechanical shear

Carving directions

Carving methods and equipment should yield smooth pieces of meat, uniform in thickness, and cut across the grain. Carve and serve only one meat sample at a time. Carve on a board instead of on a pan or a platter. Grip the meat securely with the left hand using a piece of clean cheesecloth for protection. Remove any hard brown outer covering, so that the meat will slice easily.

Take long smooth carving strokes with a sharp knife to produce a clean slice of uniform thickness without second cuts. The slices themselves should be about 5 to 7 mm. in thickness. Take care to prevent surfaces of these slices from coming in contact with the carving board, the brown outer surface of the roast, or with the fat and the juice which may have drained out.

Keep slices in their anatomical order, 1 to 5, for distribution to the respective judges. Use a knife and fork to distribute the slices.

See also specific directions for each kind and cut of meat.

Serving directions

Assign numbers from 1 to 5 to the judges. When the cooking of a series of samples lasts for more than one day the judges retain the same numbers throughout. If alternates come, assign them to the vacant places. The slices of meat cut in anatomical order are also numbered from 1 to 5. Mark individual warmed plates with the cooking laboratory serial number of the sample (not the animal designation), the number of the slice and the name of the judge to whom it is to go. For example, judge No. 1 (Mr. X) tastes 552B, slice No. 1 from plate marked 552B, 1, X, and judge No. 5 (Miss Y) tastes 552B slice No. 5 from plate marked 552B, 5, Y.

Serve each judge with one sample at a time, together with the grading chart which bears the corresponding cooking laboratory serial number and a Roman numeral for the order of serving this sample, whether I, II, etc. The distribution of the correct grading chart must be in responsible hands to prevent errors.

Seasoning is not added to the meat. To take away the taste between samples, provide the judges with water and any one of the following: Tart, firm apples, white bread, or plain sponge cake.

Judging meat for palatability

Selection of judges.— Judges put the final stamp on the value of a sample of meat which has been produced under known conditions involving considerable labor and expense. Therefore select judges with care. Choose interested and discriminating men and women who can be relied upon to give conscientious attention to meat judging whenever they are called upon. Five persons are

usually as many as can be assembled regularly to judge meat samples every day for a week or longer. Keep the personnel of the group unchanged throughout any particular experiment if possible. This is not always feasible, however, on an intensive piece of work. Hence considerably more than five persons should be trained in meat judging so that they can change one with another.

The grading chart.— The grading chart developed for scoring factors of palatability is purely descriptive. It provides for the expression of opinions of all judges in the same terms. Interpretation of terms naturally varies somewhat with judges because of individual standards. The code numbers from 1 to 7 are of no concern to the judges. The numbers are chosen arbitrarily and are used in calculating averages of several opinions.

For several factors of palatability the grading system distinguishes between two phases, degree of intensity and degree of desirability. They are not necessarily the same. For example, a strong mutton flavor may be of the same degree of intensity to two judges, but desirable to one judge and undesirable to the other.

The grading chart applies in principle to all cuts and kinds of meat studied so far in this project. Certain fundamental observations on meat are covered by the grading chart. Often it is desirable to obtain additional evidence of a special kind where the meat has been treated in some way other than the standard procedure. In such cases the chart should be amplified or modified with words descriptive of the condition sought, as has been done in preparing a grading chart for cured meats.

Principles of judging meat for palatability.— So far, there has been no attempt to set up standards, each judge being allowed to form his own on the basis of experience. It is significant that experienced judges agree better than inexperienced ones. Perfect agreement is not to be expected, nor necessarily to be desired. Keeness of perception and consistency in adhering to individual standards are important prerequisites to good judging. Experience that covers a complete range of quality is desirable, otherwise when judges are confronted with a series of meat samples not greatly different, they are likely to make distinctions which are not really significant.

The standards of a judge must remain unchanged in considering various kinds of meat or methods of cooking. For example, the various degrees of tenderness or toughness should be established in a judge's mind by wide experience and he should adhere to a single standard for all meat irrespective of any particular kind. Various evaluations may be given to judges' opinions if at any time it is desirable to develop a comparative score, but the fundamental observations rest on the same level for all kinds of meat.

Instructions to judges.— Compare the cooking laboratory serial number on the grading chart and on the plate containing the meat sample. Numbers should be identical. Check your name and slice number on the plate and see that you always receive the same slice when judging a series of samples.

For the location of fat portions and the muscles that are to be tasted refer to the drawings for the kind and cut of meat being judged, or ask the

person in charge of serving to indicate where to cut out samples from the slice of meat before you.

When the number of pieces of meat to be judged at one time is large, or when meat is strongly cured, do not swallow it. For only a few samples, mild in flavor, it is probably immaterial whether or not meat is swallowed.

Between samples of fat and lean, eat firm tart apples, plain sponge cake, or bread, and drink water to take away the meat taste.

Do not discuss scores or make comments until all judges have graded the sample before them.

Decision as to intensity, flavor, tenderness, and so forth is to be made on the basis of experience. Desirability is based on personal likes and dislikes. Intensity and desirability will not necessarily be the same. Record scores by encircling the words describing intensity and checking those for desirability. The following procedure is suggested for judging meat:

a. Score aroma first and at once because it is directly influenced by the temperature of the meat.

b. Taste the fat and score the intensity and desirability of its flavor.

c. Note the color of the lean and the color of the fat and check the proper descriptive adjectives at the bottom of the chart, or if these do not apply add words that do.

d. Score the texture or grain (by appearance) of the lean portion of the sample.

e. Chew the lean well to get its flavor, tenderness, and juiciness. In judging juiciness score both quality and quantity. Quality refers to richness or body. Quantity is simply the amount present.

f. Note under "Remarks" of the right-hand side of the chart unusual characteristics in any of the factors scored. Judicious use of this column will add valuable data. The cured meat grading chart provides words descriptive of kind of flavor, aroma, etc.

Directions for summarizing palatability scores.- In order to average the opinions of several judges, numbers have been arbitrarily assigned to the descriptive words in the grading chart. The number corresponding to any descriptive combination is found at the top of the column in which that combination occurs. To find the average tenderness of a sample, for example, assemble on Sheet 8 in the column headed "Tenderness" the numbers corresponding to the words the various judges have marked, and calculate the average. Each factor on the grading chart is considered by itself. There is no weighting of the factors and no addition of numbers to make a total score.

Mechanical shearing tests

As an objective estimate of the tenderness of the cooked meat the carver measures its resistance to mechanical shearing at the time the sample is judged by the committee. The device used for measuring the shearing resistance of meat is described in U. S. Department of Agriculture Technical Bulletin 217, "Beef production and quality as affected by grade of steer and feeding grain supplement on grass." Standard specifications for the construction and operation of this instrument are being developed.

In brief this mechanical shear consists of a thin steel blade drawn through a narrow slot in a piece of angle iron. Samples are made with a sharpened steel cylinder similar to a cork borer having an inside diameter of 1 inch. Cut samples with the grain of the meat. Core out the plug by hand from muscles shown on the drawing for the kind and cut of meat. Put as little weight as possible upon the sample and thus avoid compressing the meat and causing the lower end of the sample to be smaller in diameter than the top. Place the cored-out sample in the tester and with the hand-driven screw apply pressure enough to pull the steel blade through the meat across the grain. Make every effort to keep the speed of the hand screw at 120 revolutions per minute. For uniformity the machine should be driven by a motor and gear. Record on Sheet 9 the number of pounds registered, entering the figures under the sample designation and the name of the muscle tested.

Roasting and Testing Beef Ribs

(See General Directions for Cooking and Testing Meat for Palatability)

1. Equipment.-- (See Equipment for Cooking and Testing Meat for Palatability.) Use open roasting pans, and preferably right-angle meat thermometers.

2. Preparing beef ribs for roasting.-- The standard prime rib roast used for palatability tests consists of the 9th, 10th, and 11th ribs from the left side of the carcass. In cutting out the sample, cut close to the posterior edges of the 8th and the 11th ribs.

Line up the samples and mark the identification tags as described in the general directions. Weigh each sample and record on Sheet 2 together with measurements and descriptive data. Then store the meat at 7° to 8°C. until time to prepare for roasting.

Trim from the chine bone the hanging fat which contains blood vessels. Remove the spinal cord. If necessary to trim rib ends to make a roast fit a pan, weigh the detached piece and cook with the roast, but do not place the piece directly under the eye portion. Record weights on Sheet 3 section A. Check weights and identity.

Place a meat thermometer in each roast so that the center of the bulb reaches the center of the eye. If a right-angle thermometer is used, measure on the horizontal arm a distance equal to one-half the width of the meat over the center of the eye and insert the horizontal arm into the meat through the center of the cut surface of the eye. If a straight-tube thermometer is used, make a narrow incision with a steel skewer in the outer fat-covered surface

over the center of the mass of meat. Push the skewer down until the point strikes bone or barely touches the surface of the fleshy underside, and measure this distance. Insert the center of the bulb of the straight thermometer to one-half of this depth.

The ribs act as a natural rack for the roast. Placed with the fat covering uppermost, the roast needs no basting. Add neither water nor seasoning. Keep the samples in their pans in a refrigerator until time to sear.

3. Roasting beef ribs.- In planning the cooking schedule the weight of the rib roast of beef is the most important item. Allow on the average 20 minutes per pound for cooking time and 5 minutes extra per pound for the rise in temperature after removal from the oven. For roasts that are chunky or are very cold, allow about 22 minutes to the pound in the oven. Thin roasts with long bones usually cook in 18 minutes to the pound.

Sear beef ribs for 20 minutes at an average temperature of 260° to $265^{\circ}\text{C}.$, transfer to an oven heated to $125^{\circ}\text{C}.$, and continue to cook at this temperature until the meat thermometer registers $58^{\circ}\text{C}.$ Then remove the roast from the oven and weigh as directed on Sheet 3 section B. Check weights and the identity of each sample on its tray. Record on Sheet 5 at intervals of 5 minutes the temperature of each roast until it rises to $62^{\circ}\text{C}.$, or its maximum temperature below $62^{\circ}\text{C}.$ Then reweigh according to Sheet 3 section C. Carve meat as soon as the second weighings have been made.

4. Carving and sampling beef ribs.- Remove the roast from the tray to the carving board. Lift the meat off the bones after cutting first close to the spinal processes, and then making a second cut that separates the roast from the ribs in the same manner that spareribs are removed from a pork side. Lay the boned roast flat on the board. Remove the meat lying over the 11th rib (about $1/3$ of the roast) and lay it aside for the mechanical shearing test. Next cut a slice 5 to 7 mm. thick and let it fall onto the carving board. Do not serve this piece to judges. Cut for the judges five uniform slices (5 to 7 mm. thick) letting them fall in a neat pile on top of the slice lying on the board. Serve the slice on top of the pile to judge No. 5, and the slice next the bottom to judge No. 1. See Figure 1 for location of the lean and the fat portions to be tasted by the judges.

From the thick piece over the 11th rib, core out samples located as in Figure 2. If the brown outer portion is laid on the board and the sampler started through from the cut side, it is possible to secure a sample of more nearly uniform width.

Roasting and Testing Leg of Lamb

(See General Directions for Cooking and Testing Meat for Palatability)

1. Equipment.- (See Equipment for Cooking and Testing Meat for Palatability.) Use open pans, racks, and straight-tube meat thermometers.

2. Preparing leg of lamb for roasting.- The standard lamb leg is removed from the carcass by a cut across the back just forward of the external angle

of the ilium. In trimming take care only to smooth off the cod or udder fat and not to expose the lean.

Line up the samples, mark the identification tags, and record descriptive data on Sheet 2a. Take the measurements for locating the meat thermometer as shown on Sheet 2a. Insert a pin at P to mark the place for the thermometer. Measure the depth, or thickness, of the round at P, by means of two rulers held at right angles to each other. Saw off piece marked "bone end" on Sheet 2a, and be careful not to disturb the pin at P.

Do not remove the fell.

Experiments show that removing the fell increases cooking losses, decreases the rate of heat penetration, and does not definitely affect the flavor.

Weigh as indicated on Sheet 3 section A. Check weights and identity. Place the leg on a rack in a pan with the skin-side down and the inside round up. Insert the center of the bulb of the meat thermometer to one-half the depth of the leg at P. Add neither water nor seasoning. Keep the samples in their containers in the refrigerator until time to sear.

3. Roasting leg of lamb.-- Allow approximately 35 minutes to the pound for lamb, but expect considerable variation. Increase the time allowance per pound for very small legs or those severely trimmed, and decrease for plump, well-finished, unutilated legs. In summer when the initial temperature of the meat can not be held as low as 8°C., the cooking time is somewhat less than the average. Well-ripened legs require less time than those cooked while "green."

Sear lamb 20 minutes at an average temperature of 260° to 265°C. Transfer to an oven at 125°C., and continue to cook until the meat thermometer registers 76°C. Remove from the oven and weigh at once as directed on Sheet 3 Section B. Because very little, if any, rise of temperature has been noted in hundreds of samples cooked according to these directions, disregard it. Check weights and the identity of each sample on its tray. Carve immediately.

4. Carving and sampling leg of lamb.-- Place the roasted leg on the carving board and hold with the stifle down and thick portion up. (See Fig. 3.) Start slicing across the leg at the lower or shank side of the popliteal gland and continue slicing through the gland and toward the pelvic bone. Discard the slices that do not contain sections of the gland. Use the 1 or 1-1/2 inches of unsliced meat left attached to the pelvic bone for the mechanical shearing test. With a narrow knife detach the slices from the leg bone, and place directly on the correct plate. The slice for serving to judge No. 1 is the first one that carries a section of the fat around the popliteal gland. The semimembranous muscle is fairly small in this slice. Cut out the popliteal gland, but leave the surrounding fat as the sample for the palatability committee.

Serve the whole slice, although only the semimembranosus muscle and fat indicated in Figure 4 are tasted by the judges.

Cut off in one piece the meat remaining attached to the pelvic bone and take the sample for the mechanical shearing test as indicated in Figure 4.

Roasting and Testing Veal

(See General Directions for Cooking and Testing Meat for Palatability)

1. Equipment.- (See Equipment for Cooking and Testing Meat for Palatability.) Use covered, rectangular roasters of 22-gauge sheet iron. A convenient size is 8 by 13 inches, with top and bottom pans each 3-1/2 inches deep. Each bottom pan should have two circular openings, one-half inch in diameter, one cut in the middle and the other one inch from the end of the same long side, and one-half inch from the top edge. Use racks in the pans.

Thermometers should be of the right-angle type with 5-inch horizontal arm, and 8-inch upright stem containing graduations. A range of 0° or 40° to 100°C. is recommended for the meat thermometer, and 100° to 250° or 275°C. for the thermometer used to obtain the temperature of the air in the covered roaster.

2. Preparing veal for roasting.- The thigh section of leg cut through the femur just inside the enlarged joint ends in the standard cut of veal. The straight length of the bone may vary from 3 to 4 inches.

Line up the samples and mark the identification tags as described in the general directions. Describe color and texture of the lean meat; color, character and location of the fat; and measure length, width, and depth of each roast. Store at 7° to 8°C. until time to prepare samples for roasting.

Weigh as directed on Sheet 3 section A, weighing only the lower part of the covered roaster. Check weights and identity. Place the meat on a rack in the pan, with the inner surface of the leg uppermost. Insert meat thermometer through the middle opening in the lower pan into the center of the large fleshy half of the cut. Insert the other thermometer into the second opening in the lower pan, to register the temperature of the air within the closed roaster. Secure the thermometers in place in the holes by means of asbestos plugs. If the roast will not stand upright, use two or three wooden skewers to prop it up. Add neither water nor seasoning. Keep samples in their pans in a refrigerator until time to sear.

3. Roasting veal.- Allow 20 minutes to the pound for roasting veal, and 5 minutes per pound for the temperature to rise outside the oven.

Sear veal without a lid for 20 minutes at an average temperature of 260° to 265°C. Transfer the roast to an oven at 125°C., put on the lid, and continue the cooking until the meat thermometer registers 71°C. Then remove roaster from the oven and allow it to stand covered about half an hour or until the meat reaches its maximum temperature reading. Take off the lid and drain thoroughly any moisture on it into the lower pan. Weigh the meat and the lower pan, etc. as directed on Sheet 3 section B. Check the weights and the identity of the samples on the trays. Carve immediately.

4. Carving and sampling veal roasts.- Beginning at the edge of the roast with the semimembranosus and semitendinosus muscles, cut straight across to the bone, the full width of the roast. Either remove or turn back the first

slice as the browned outer surface will influence the flavor. Cut uniform slices approximately 5 to 7 mm. thick for the judges. Lay each slice as it is cut on a marked plate. See figure 4 for location of semimembranosus and biceps femoris to be tasted by judges.

Roasting and Testing Pork Loin

(See General Directions for Cooking and Testing Meat for Palatability)

1. Equipment.-- (See Equipment for Cooking and Testing Meat for Palatability.) Use open pans, racks, and straight-tube meat thermometers.

2. Preparing pork loin for roasting.-- The center part of pork loin including the last four dorsal and first four lumbar vertebrae is the standard cut. The fat covering should be intact without gashes or breaks, and uniformly one-half inch thick.

Line up the samples and mark the identification tags as described in the general directions. Record the descriptive data on Sheet 2b. Store the samples at 7° to 8°C. until time to prepare for cooking.

Remove the spinal cord. Weigh as indicated on Sheet 3 section A. Check weights and identity. Place the loin fat side up in the pan for self basting. Use racks because the rib ends of the loin are short.

Make an incision with a steel skewer through the fat covering where the meat is thickest at a point opposite the division of the second and third lumbar vertebrae. This is generally 1-1/2 to 2 inches from the vertebral column. Push the skewer down until the tip almost penetrates the under side. Measure the portion of the skewer in the meat and record this depth at the bottom of Sheet 3. Insert the meat thermometer through the incision to a depth equal to one-half the thickness of the meat, measuring from the center of the bulb. (See Fig. 5.) Add neither water nor seasoning. Keep samples in their pans in a refrigerator until time for searing.

3. Roasting pork loin.-- Allow on the average from 30 to 35 minutes per pound. Allow fewer minutes per pound to cook loins with very thick fat covering, and more for loins that are stripped bare and mutilated.

Heat the searing ovens to 260°C. Sear pork loin for 20 minutes at an average temperature of 250° to 255°C. Transfer the meat to an oven at 150°C. and continue the cooking until the meat thermometer registers 84°C. Weigh as indicated on Sheet 3 section B. Check the weights and the identity of the samples on the trays. The rise in temperature is slight, if any, and is disregarded.

Describe the cooked sample on Sheet 2c and carve immediately.

4. Carving and sampling roast pork loin.-- Divide the loin roast between the last thoracic and the first lumbar vertebrae. Bone the loin portion, leaving the tenderloin on the short T-bones. Remove the brown outside fat.

Beginning at the freshly cut surface, slice a piece 5 to 7 mm. thick and let it fall onto the carving board. Do not serve this piece to the judges. Cut for the judges five slices, each 5 to 7 mm. thick, letting them fall in a neat pile on top of the slice on the board. Serve the top slice on the pile to judge No. 5, and the slice next to the bottom to judge No. 1. Fat and lean portions to be tasted are shown in Figure 1.

After the judges' samples are on the plates and there is no danger of confusing loin and rib ends, bone the rib end of the roast. Use the remaining portion of the loin end as sample No. 1 for mechanical shearing tests. Take sample No. 2 from the rib end, using the section attached to the last thoracic vertebra. This will lie one slice removed from slice No. 1 of the judges' samples.

Roasting and Testing Fresh Half Ham

(See General Directions for Cooking and Testing Meat for Palatability)

1. Equipment.-- (See Equipment for Cooking and Testing Meat for Palatability.) Use open pans to fit roasts, racks, and straight-tube meat thermometers

2. Preparing fresh half ham for roasting.-- Remove the butt from the regular short-cut, trimmed ham by cutting just behind and parallel to the exposed projection of the aitch bone. Cut close to the bone, making the butt as small as possible.

Line up the samples and mark the identification tags as described in the general directions. Do not remove the rind. Weigh the samples and record the descriptive data on Sheet 2b. Store in a refrigerator at 7° to 8°C. until time to prepare for cooking.

Record weights on Sheet 3 section A. Check weights and identity.

In locating the meat thermometer in a fresh half ham, the object is to place the center of the bulb in such a position that it will be equally distant from the surface of the meat at all points. Make allowance for the distance between the cut face and the rounded surface of the leg where the muscles begin to swell above the joint. If the thermometer is placed too far back the bulb is closer to the shallow section under the rind and may tend to give a higher temperature than the true center and the meat will therefore be underdone. The depth of the cut from the face to the "hock end" must be considered. While 3 inches will generally give a fairly accurate estimate of the correct position for inserting a skewer, in small hams this is too much to allow. For very small hams insert a skewer through the rind about 2 inches from the cut face. Punch a hole through the rind with the skewer, then enlarge the hole with scissors. Push the skewer through perpendicular to the rind and parallel to the cut face until the point almost penetrates the opposite side. Measure the distance the skewer was immersed and record at the bottom of Sheet 3. Insert the meat thermometer into the incision so that the center of the bulb penetrates to a depth equal to half the measured thickness of the piece of meat. Place the half ham on a rack

in an open pan, rind side up. Add neither water nor seasoning. Keep the samples in their pans in a refrigerator until time to sear.

3. Roasting fresh half ham.- Allow on the average 30 to 35 minutes per pound to cook fresh half hams. Very large hams frequently take less than this and small hams take more time per pound. In planning schedules allow an interval of 12 to 15 minutes for the carving of successive samples.

Heat the searing ovens to 260°C. Sear the half hams for 15 minutes at an average temperature of 250° to 255° C. Transfer the samples to ovens at 150°C. and continue the cooking until the meat thermometer registers 84°C. Remove from the oven and weigh as directed on Sheet 3 section B. The rise of temperature after removal from the oven is slight if any, and is disregarded. Check the weights and the identity of the samples on the trays. Describe on Sheet 2c the appearance of the cooked half hams. Carve immediately.

4. Carving and sampling roast fresh half hams.- Loosen the ham rind with a knife and remove by pulling it off over the hock end. Place the ham on the carving board stifle down and the thick portion up. (See Fig. 3.) Remove a piece about 1 to 1-1/2 inches thick, and set it aside for the mechanical shearing test. Remove any remaining brown outer portion of the fat. Slice the ham 5 to 7 mm. thick, straight across to the bone. Lay the pieces as cut on the plates marked to receive them. Give the slice nearest the butt end to judge No. 5, and that nearest the hock end to judge No. 1. For location of semimembranosus and biceps femoris, lean samples to be tested by judges and by mechanical shear, see Figure 4. Fat for the judges is taken from the outer edge of biceps femoris.

Baking and Testing Cured Ham

(See General Directions for Cooking and Testing Meat for Palatability)

1. Equipment.- (See Equipment for Cooking and Testing Meat for Palatability.) Use open pans, racks, and straight-tube meat thermometers.

2. Preparing cured hams for baking.- Line up the samples, mark the identification tags as described in the general directions. Scrub, but do not remove the rind, and weigh. If the investigation involves soaking hams before baking, soak all hams in any series of experiments under the same conditions as regards time and quantity of water used. In general, use a quart of water to a pound of meat. Use nonrusting metal tags to identify hams while soaking. At the end of the soaking period, from 12 to 20 hours, drain ham for 10 minutes, and weigh as directed on Sheet 3 section A. Check weights and identity.

Estimate with the eye the best location for the meat thermometer. The object is to find the center of the thickest portion of the ham where presumably the rate of heat penetration is slowest. With a steel skewer make an incision through the rind where the ham is thickest. Push the skewer through perpendicular to the rind until the point almost penetrates the opposite side. Withdraw the skewer and measure the depth it was immersed in

the ham and record at the bottom of Sheet 3. With sharp scissors cut around the hole in the rind to make it large enough for the meat thermometer. Then insert the meat thermometer into the incision so that the center of the bulb penetrates to a depth equal to half the measured thickness of the ham. Place the ham on a rack in the pan, rind side up. Add neither water nor seasoning.

3. Baking cured ham.- Allow on the average 27 minutes per pound to bake cured hams. Bake hams at 125°C. constant oven temperature until the meat thermometer registers 76°C. Weigh as directed on Sheet 3 section B. Check the weights and the identity of the samples on the trays. Record on Sheet 5 at 5 minute intervals the temperature of each ham until it rises to its maximum. There may be as much as 5° rise over a period of 45 to 60 minutes. Weigh as indicated in Sheet 3 section C. If the ham is to be carved hot, proceed at once. If it is to be judged cold, hold until the next day and chill thoroughly.

4. Carving and sampling cured hams (baked or cooked in water).- When hams are judged hot, remove the rind, carve, and sample by the method described for leg of lamb. Judges taste semimembranosus and biceps femoris and take fat samples from the outer edge of biceps femoris. Use Sheet 7a.

When hams are judged cold, cut parallel to the aitch bone as shown by line AB in Figure 6. Saw through the femur and remove the butt. Locate a point C below the stifle joint. Insert a boning knife to the femur at a point X, midway between C and AB. Cut along the femur from X to AB, meeting AB at D. Then cut from X to C. Turn the ham over and cut along the opposite side of the femur meeting the first cut at C. Remove the piece of meat with the surface BDC. This piece contains the patella. The femur is now exposed. Next cut to the stifle joint in a line EF parallel to AB. Remove the femur and the rind from the meat portion represented by ADFE. Place the section ADFE, fat side up, on the carving board. Remove a piece 1-1/2 inches thick for the mechanical shearing test as indicated in Figure 6. Cut slices 5 to 7 mm. thick for the judges, No. 5 slice from the end nearest the shearing sample and other slices following towards the hock. Lay each slice as cut on a cold plate marked for it. Sample in the same way as when judged hot.

Use and summary of cured meat grading chart.- Grade all cured ham (hot or cold) on Sheet 7a. Score intensity as usual. Desirability scores are not required but may be written under "Remarks" if a judge wishes to do so. A series of words descriptive of kind of aroma and flavor is included in this chart. Check appropriate words. When more than one applies, direct an arrow to the degree of intensity of each kind checked. Sheet 8 is inadequate for summarizing scores from Sheet 7a. Follow the usual system for averaging intensity scores, but use a larger sheet of paper. Summarize opinions on kinds of aroma and flavor in any way that is most convenient. Code numbers have not been assigned to these words.

Cooking Cured Ham in Water

(See General Directions for Cooking and Testing Meat for Palatability)

1. Equipment.- (See Equipment for Cooking and Testing Meat for Palatability.) Use ham boilers with covers, straight-tube meat thermometers, and,

for taking the temperature of water, ordinary laboratory thermometers.

2. Preparing cured ham for cooking in water.- See directions for baked ham, but measure the thickness with rulers held at right angles to each other. Select a boiler of such size that a quart of water to each pound of meat will at least cover the ham.

3. Cooking cured ham in water.- After inserting the thermometer as directed, place each ham, rind side up, on a rack in a ham boiler. Add water to cover the ham, preferably a quart for each pound of meat. Partly cover the boiler and simmer the ham at a temperature of 83°C. Take the temperature of the water every 5 minutes for 1/2 hour and after that every 15 minutes. The time required for cooking will be about 27 minutes per pound. From time to time add more water at 83°C. to keep the ham covered.

When the temperature of the ham reaches 76°C. remove the boiler from the stove. Record the temperature of the ham every 5 minutes until the maximum is reached. Remove the ham, drain for 10 minutes, and weigh as directed on Sheet 3 section C.

If the ham is to be judged hot, carve immediately. If the ham is to be judged cold, let each ham stand in its liquor overnight (16 hours) in the refrigerator at 7° to 8°C. The next day take the ham out of the liquor, drain for 10 minutes, weigh, recording weights at the bottom of Sheet 3, and proceed with the carving. If refrigerator space is limited, discard the liquor and chill the hams for about 16 hours at 7° to 8°C. Weigh the hams before carving.

4. Carving and sampling cured ham cooked in water.- See directions for baked ham.

Cooking and Testing Bacon

(See General Directions for Cooking and Testing Meat for Palatability)

1. Equipment.- (See Equipment for Cooking and Testing Meat for Palatability.) Use open roasting pans fitted with wire racks, planimeter, and calipers.

2. Preparing bacon for cooking.- Obtain bacon samples as follows: Cut bacon side according to the directions for hog-carcass cutting and mark the side of bacon with a knife at the flank side of the sixth rib (cut down to skin so that the mark can be seen when the bacon side is trimmed.) Store 24 hours in cooling room at 4°C. before judging cured and smoked bacon strip.

Skin the bacon. Cut bacon side at the marked place parallel to the end. Cut slice 1/4 inch thick from the flank end, and make a wax or parchment paper tracing of this slice. Record description on Sheet 2d. From shoulder end of bacon side cut slices 3/32 inch thick with a slicing machine. Make a parchment paper drawing of the first slice, choose alternate slices for shrinkage tests, and cook the others for judging. Allow one piece for each judge.

3. Cooking bacon for shrinkage.— Select 6 to 8 slices totaling 113 grams. Weigh as directed on Sheet 3 section A, changing the wording to apply to bacon. Lay cold slices of skinned bacon on a rack 1/2 inch from the bottom of an open pan and cook in an oven at 162° C. for 18 minutes. Do not turn the slices. Weigh as directed on Sheet 3 section F. Calculate the shrinkage from data on Sheet 3 and record on Sheet 4.

4. Cooking bacon for judging.— For judging, cook bacon as described above until crisp, an even light brown, and no longer translucent. The time required will be approximately 18 minutes, but it is advisable to make a preliminary test because time varies with cure, grade, and fat of individual hogs. Drain the bacon on absorbent paper before serving on hot plates to judges. Use the cured-meat grading chart, Sheet 7a, as directed for cured ham.

Roasting and Testing Beef Chuck (Tentative)

(Supplied by Jessie A. Cline, Missouri Agricultural Experiment Station)

(See General Directions for Cooking and Testing Meat for Palatability)

1. Equipment.— (See Equipment for Cooking and Testing Meat for Palatability.) Use open pans, racks, and right-angle meat thermometers.

2. Preparing beef chuck for roasting.— The roast consists of the first and second ribs of the beef carcass. In cutting out the sample cut close to the second rib and the anterior edge of the first rib.

Record description on Sheet 2. Take measurements at the rib end of the roast. Do not trim. Record weights on Sheet 3 section A. Place the meat on a rack so that the muscle to be tested is on top. Insert the meat thermometer in the roast so that the center of the bulb reaches the center of the infraspinatus muscle. (See Fig. 7.) Do not add water or seasoning. Roasts should have an initial temperature of 8° to 10° C. when put into the ovens.

3. Roasting beef chuck.— In planning the cooking schedule allow approximately 18 minutes per pound for cooking time and 2 minutes extra per pound for rise in temperature after removal from the ovens, when roasts have an initial temperature of 8° to 10° C. For colder roasts allow more time.

Place pans containing roasts crosswise in the center of ovens heated to 125° C. and hold this temperature constant. Remove a roast from the oven when the meat thermometer registers 62° C. Weigh as directed on Sheet 3 section B. Allow the roast to stand until it reaches its maximum temperature. Weigh as directed on Sheet 3 section C.

4. Carving and sampling beef chuck.— See directions for beef ribs for method of carving and sampling. Use the center part of the infraspinatus muscle.

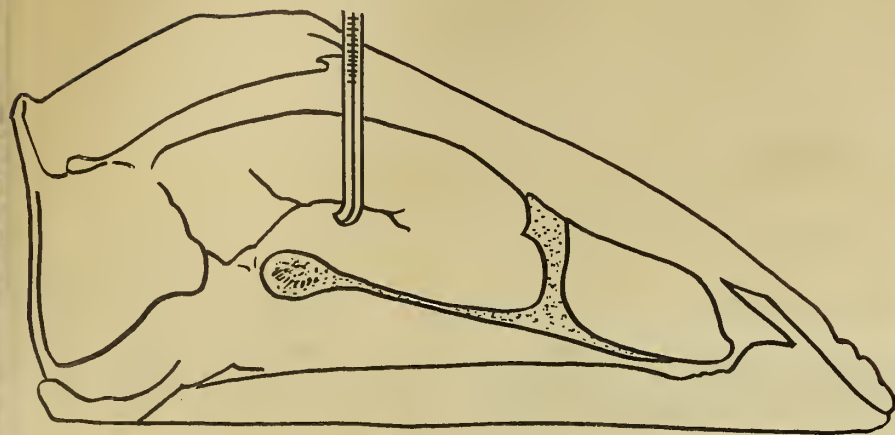


Fig. 7. Chuck roast of beef showing thermometer in infraspinatus.

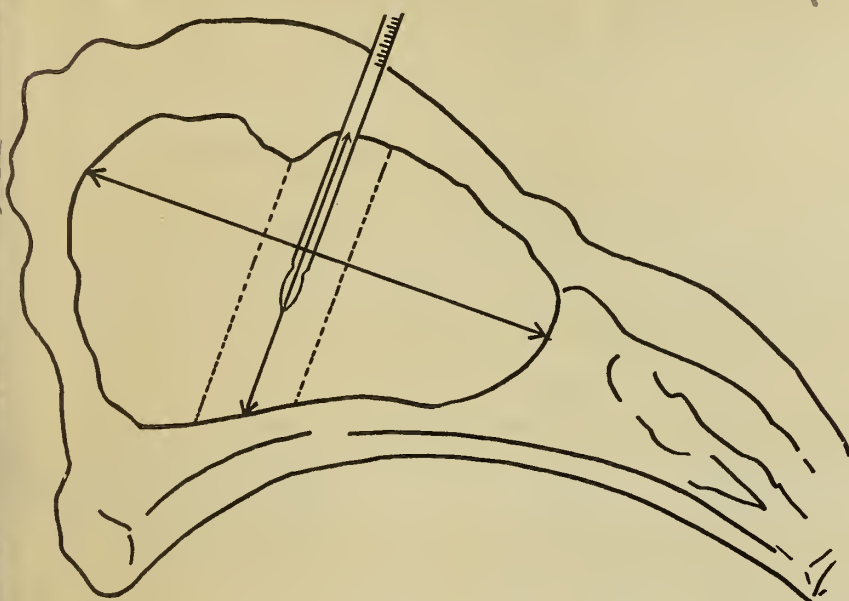


Fig. 8. Location of meat thermometer and judges' samples in rib steak.

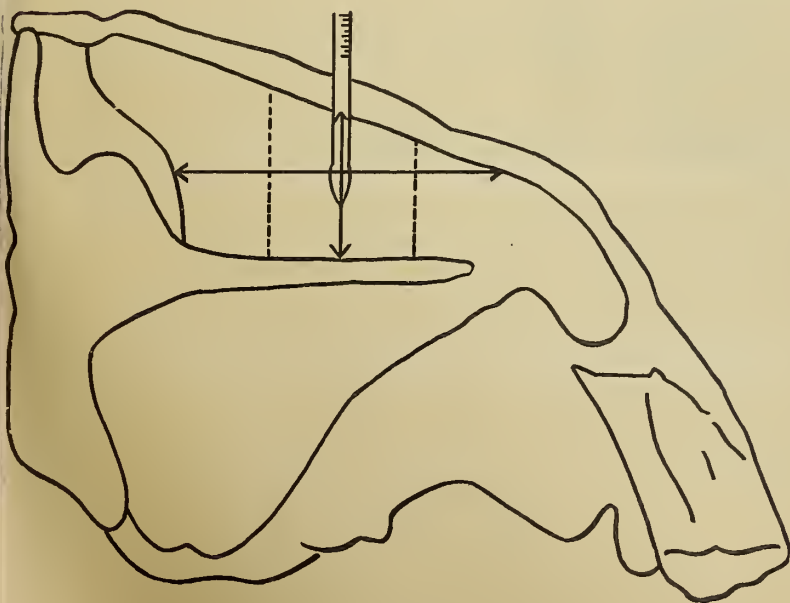


Fig. 9. Location of meat thermometer and judges' samples in porterhouse steak.

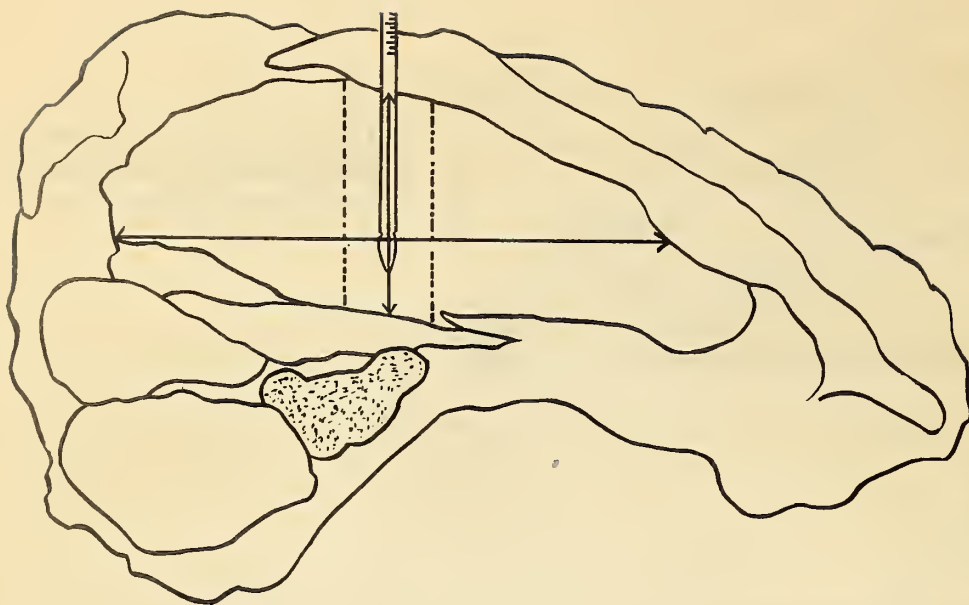


Fig. 10. Location of meat thermometer and judges' samples in sirloin steak.

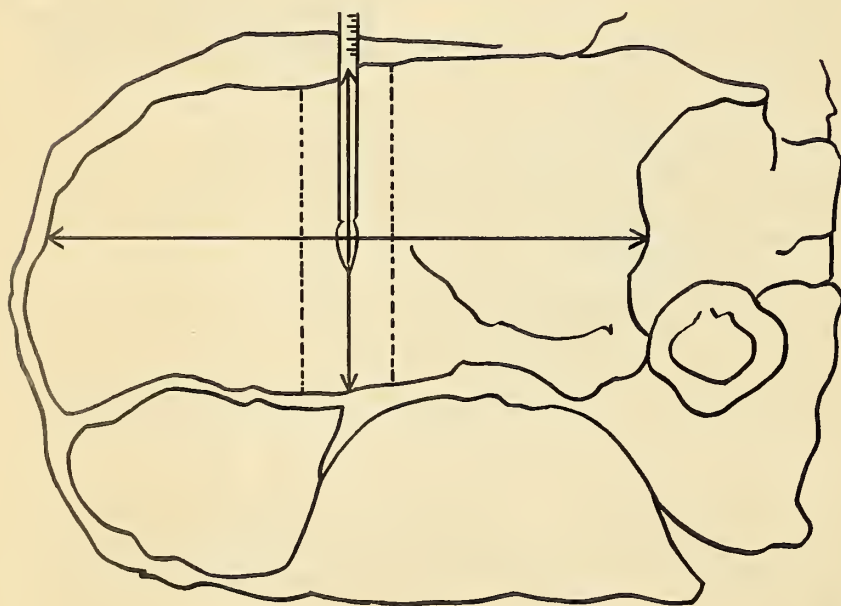


Fig. 11. Location of meat thermometer and judges' samples in round steak.

Broiling and Testing Beefsteaks (Tentative)

(Supplied by Jessie A. Cline, Missouri Agricultural Experiment Station)

(See General Directions for Cooking and Testing Meat for Palatability)

1. Equipment.— (See Equipment for Cooking and Testing Meat for Palatability.) Use direct-action gas broiler ovens, broiler pans and broiling rods to fit broilers, fireless cooker thermometers, straight-tube meat thermometers.

2. Preparing beefsteaks for broiling.— Cut all steaks 2 inches thick. For rib steaks, use the 12th rib. For porterhouse, use the first cut from the short loin, next to the loin end. For sirloin, use the first cut from the loin end, next to the rump. For round, use the first cut from the round, next to the rump.

Record description of sample on Sheet 2.

Record weighings indicated on Sheet 3 section A, changing the wording to apply to beefsteaks. Check weights and the identity of each sample. Insert a meat thermometer horizontally into the steak so that the center of the bulb reaches the center of the muscle to be tested. (See Figs. 8-11.) Add no seasoning. Keep the steaks in a refrigerator until time to cook.

3. Broiling beefsteaks.— In planning the cooking schedule allow approximately the following time for steaks with temperature of 10° to 12°C . Rib steaks, 15 minutes per pound, or a total of 35 minutes in the broiler. Porterhouse and sirloin steaks, 10 to 11 minutes per pound, or a total of 35 to 40 minutes in the broiler. Round steaks, 8 minutes per pound, or a total of 40 to 45 minutes in the broiler. For all steaks add approximately 15 minutes to the cooking time for rise in temperature after removal from the broiler. If the initial temperature of steaks is colder than 10° to 12°C . allow more time in the broiler.

Place the broiler pan with its rods in the broiler so that there is a distance of 5-1/2 inches between the burner and the rods. Place a fireless cooker thermometer to the left front, on the last two rods, and even with front edge of the broiling rods or rack. Heat the broiler with the door closed, until the fireless cooker thermometer registers 177°C . Place the steak on the center of the broiling rack with the meat thermometer to the right. Place rib, porterhouse, and sirloin steaks with the small end toward the front, and round steaks with the round uncut edge to the front. Broil with the broiler door open until the meat thermometer registers about 40°C . Turn once, end for end, so that the meat thermometer after turning is still on the right side, and continue broiling with the broiler door open, until the meat thermometer registers 58°C . Then remove the steak from the broiler and weigh as directed on Sheet 3 section B. Check weights and identity of samples. Record on Sheet 5 at intervals of 5 minutes the temperature of each steak until it rises to 62°C ., or its maximum temperature below 62°C . Then weigh according to directions on Sheet 3 section C.

4. Carving and sampling beefsteaks.— Remove the broiled steak from the tray and place upon the carving board. (See Figs. 8, 10 and 11.) Cut out a

piece 1 inch wide from the center of the muscle to be tested. Remove the browned portion from each side of this piece and cut horizontally into two slices, making each slice one-half the thickness of the steak. Then cut each slice vertically, thus making samples for judges. From porterhouse steak remove a piece 2 inches wide (Fig. 9.)

Suggestions for Conducting Experiments in Meat Cookery

Comparison of cooking methods.— For comparison of cooking methods select corresponding right and left cuts from carcasses representative of several grades of quality. Cook the right-hand cuts by one method and the left-hand by another. If after cooking, one of the pair of cuts differs from the other markedly in appearance, shrinkage, or palatability, it is probably safe to assume that the difference is due to cooking. However, before drawing conclusions repeat the experiment on not less than 10 pairs and preferably more to see whether they show consistent trends for the series as a whole.

Comparison of cuts of meat.— For comparing inherent qualities such as tenderness of different cuts of meat obtain cuts from the same carcass and cook all from one side of the carcass in the same way. It is recommended that the standard cut used for palatability tests always be included and that the standard method of cooking be among those employed for all cuts. However, cooking methods other than the standard may be better suited to certain cuts of meat. If in addition to comparing cuts it is desired also to demonstrate the superiority of one method of cooking over another for any particular cut, compare various cuts cooked by the new method with the corresponding cuts cooked by the standard method. Before drawing conclusions, repeat the tests using meat from carcasses representing several grades of quality.

Evaluation of results.— In experimental meat cookery it is tedious work at best to accumulate sufficient data to support sound conclusions. It is, therefore, important to reduce to the minimum the number of variables in an experiment and thus make the most efficient use of all meat samples. If comparisons of two methods of cooking are always made on pairs of cuts, it is probably safe to assume that for each pair the composition of the meat is constant, and any differences that show up are due to the cooking. Hence fewer repetitions are needed than when unpaired cuts are used. No two pairs will show exactly the same results from cooking because the meat from different animals varies in composition. Consistent variation through a series of pairs is what counts when deciding whether one method of cooking affects meat differently from another.

Interpretation of palatability grades presents special problems. Guard against the error of attributing significance to small differences between palatability grades. As a check, cook paired cuts by the same methods and judge them. When this is done, unexpected differences are sometimes found. They may be due to the meat or to the judging. Anyway they are important and should be considered when deciding to what extent cooking method or any other treatment affects the palatability of meat.

When studying the merits of different cooking methods, remember that experimental cookery is one thing and practical cookery another. When recommending a cooking method for use in the home or in an institution kitchen, always consider the appearance of the cooked meat, satisfactory cooking of every part of a cut, shrinkage, time required, and fuel consumption.

